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Landau level occupation detection as a novel THz detector scheme

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Abstract

The military, and in particular the Air Force, has invested relatively little money in THz research and development. There are two main reasons for this. The THz band has lacked technological maturity, both in an absolute sense and as compared to the MHz, GHz, mid and near IR regimes. Second, THz radiation is readily absorbed in the atmosphere. In space, the 2nd difficulty disappears, which leaves only the first issue. One possible application of THz technology is in satellite to satellite communication. Increasingly sensitive sensors on satellites collect vast amounts of data. This data must be communicated both to the ground and to other satellites. This requires a higher carrier frequency. Ideally this would be an IR or visible carrier. However, these carriers have their own intrinsic problems. THz carriers would largely avoid these problems while providing better data throughput over what is currently utilized. To convince the Air Force that this is a viable alternative, we need better THz sources and detectors. Our lab has been exploring alternative THz detector technologies. One such technology is the design of metamaterials where the periodicity and size of the inclusions are designed for absorption in the THz. Our prototype is remotely tunable, absorbs in the THz, and sensitive to GHz modulation. The tunability and response is achieved via HEMT type transistors interleaved throughout the periodic inclusions in the metamaterial. Another type of detector project that we have started seeks to selectively populate Landau levels in a semiconductor sample. We will discuss both projects.

Biography

Mayer Landau completed an MS in electrical engineering in 1999 at the University of Michigan and obtained his PhD in optics at the University of Rochester's Institute of Optics in 2010. He has worked previously as a staff scientist at Los Alamos National Laboratory's Meson Physics Facility and at MIT Lincoln Lab's radar division. Currently, he works as a research physicist in the space directorate of the US Air Force Research Laboratory.